"The Effects of a strong Magnetic Field upon Electric Discharges in Vacuo." By A. A. C. SWINTON. Communicated by LORD KELVIN, F.R.S. Received June 10,—Read June 18, 1896.

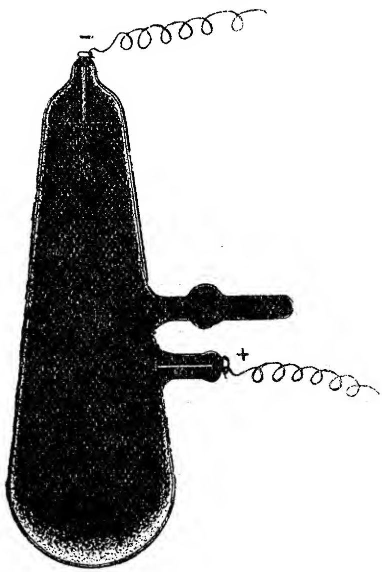
As is well known, when the lines of force of a magnetic field cut the path of the cathode rays in a vacuum tube, the rays are deflected in one direction or another, according to the polarity of the lines of force. If, on the other hand, the relative positions of the vacuum tube and the magnet are such that the lines of force and the cathode rays are parallel, the rays are not sensibly deflected.

Under certain circumstances, however, I have found that with the rays and lines of force parallel, other phenomena occur both in regard to the appearance of the discharge and in connexion with the internal resistance of the tube.

The apparatus employed consisted of a Crookes tube of the form illustrated, supported vertically over one pole of a straight electromagnet. The tube, which was excited by means of a 10-inch Ruhmkorff coil, working much below full power, was about 11 inches in length. The cathode terminal consisted of an aluminium plate at one end of the tube, and the anode a similar plate at one side. The tube was exhausted to a degree that gave considerable green fluorescence of the glass, with a very slight trace of blue luminescence of the residual gas in the neighbourhood of the cathode and anode. The magnet employed had a soft iron core 12 inches in length and $1\frac{7}{8}$ inches diameter. It was wound with 2376 turns of No. 18 S.W.G. copper wire, which, when supplied with continuous electric current at 100 volts pressure, allowed from 13 to 14 ampères to pass, and magnetised the iron core practically to saturation.

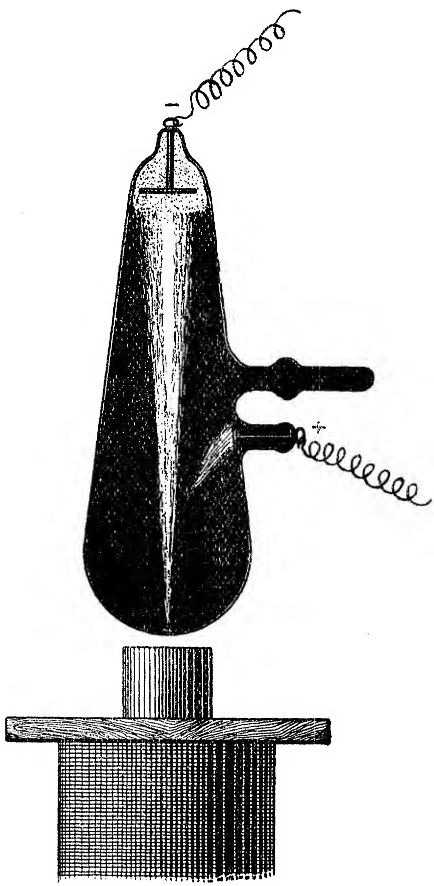
When the Ruhmkorff discharge passed through the tube, the magnet not being excited, the general appearance was as shown in fig. 1, the walls of the tube showing everywhere green fluorescence, which was especially strong all over the rounded end of the tube opposite the cathode. A very small amount of blue luminescence could also be faintly seen just below the cathode, and also in the vicinity of the anode.

With the tube and magnet placed as in fig. 2, as soon as the magnet was excited, the whole appearance of the discharge in the tube was found to alter immediately to what is shown in the illustration. Excepting for a very little at the top of the tube near the cathode, and a very bright spot at the bottom immediately over the magnet pole, all the green fluorescence of the glass disappeared, while extending from near the cathode to the bright spot at the



— FIG: 1. —

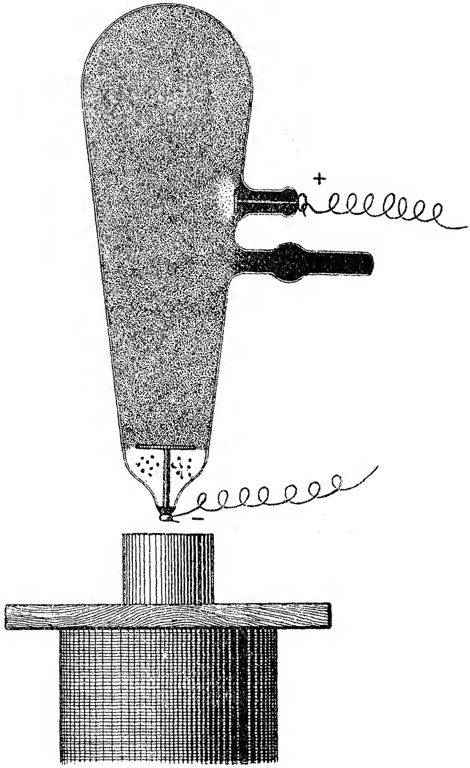
bottom of the tube, a very bright cone of blue luminescence with a still brighter whitish blue core, made its appearance. When under these conditions the tube was slightly moved sideways, the bright spot at the apex of the cone, and the cone itself moved, the spot and apex always maintaining a position exactly over the centre of the magnet pole. At the same time the minor blue luminescence proceeding from the anode terminal, due probably to the "make" current of the Ruhmkorff coil, was bent downwards towards the magnet as shown, and deflected sideways one way or another according to the polarity of the magnet, which polarity, however, did not affect in any way the vertical cathode stream. The internal resistance of the tube, as measured by an alternative spark gap on the Ruhmkorff coil, was also found to be very greatly diminished while the magnet was excited. With the magnet not excited, the alternative spark would leap from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches, while, when the magnet was excited, the gap had to be reduced to about $\frac{1}{8}$ inch before the sparks would pass. As soon as the current from the magnet was cut off, the appearance of the tube immediately reverted to what is shown in fig. 1, and its internal resistance increased to what it had been before.



— Fig: 2. —

Experiments were also tried with the tube reversed as shown in fig. 3. In this case the internal resistance was affected by the magnet just as it had been previously. The appearance of the tube was also altered by the diminution almost to vanishing point of the green fluorescence, the presence of very bright blue luminescence on the under side of the cathode next the magnet, some less bright blue fluorescence near the anode, and a considerable amount of faint blue luminescence throughout the remainder of the tube.

In this case, as in the other, the tube reverted to its normal appearance as soon as the magnet was demagnetised, and the appearance was the same whether the pole of the magnet next the tube was north or south.



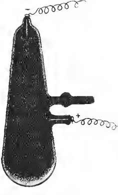
— Fig. 3. —

Further experiments with the tube placed horizontally so that the magnetic lines cut the cathode rays produced the usual deflection of the latter, but did not seem to have any appreciable effect on the internal resistance of the tube.

"The Hysteresis of Iron and Steel in a Rotating Magnetic Field." By Francis G. Baily, M.A. Communicated by Professor Lodge, F.R.S. Received April 9,—Read June 4, 1896.

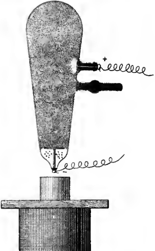
(Abstract.)

That the hysteresis of iron varies with the conditions of magnetic change has been ascertained in some instances, notably those in which the attractions between the molecular magnets of the Weber-Maxwell-Ewing theory are diminished by super-imposed vibrations in the



— Fig I —

— Fig. 2 —



— Fig. 8 —